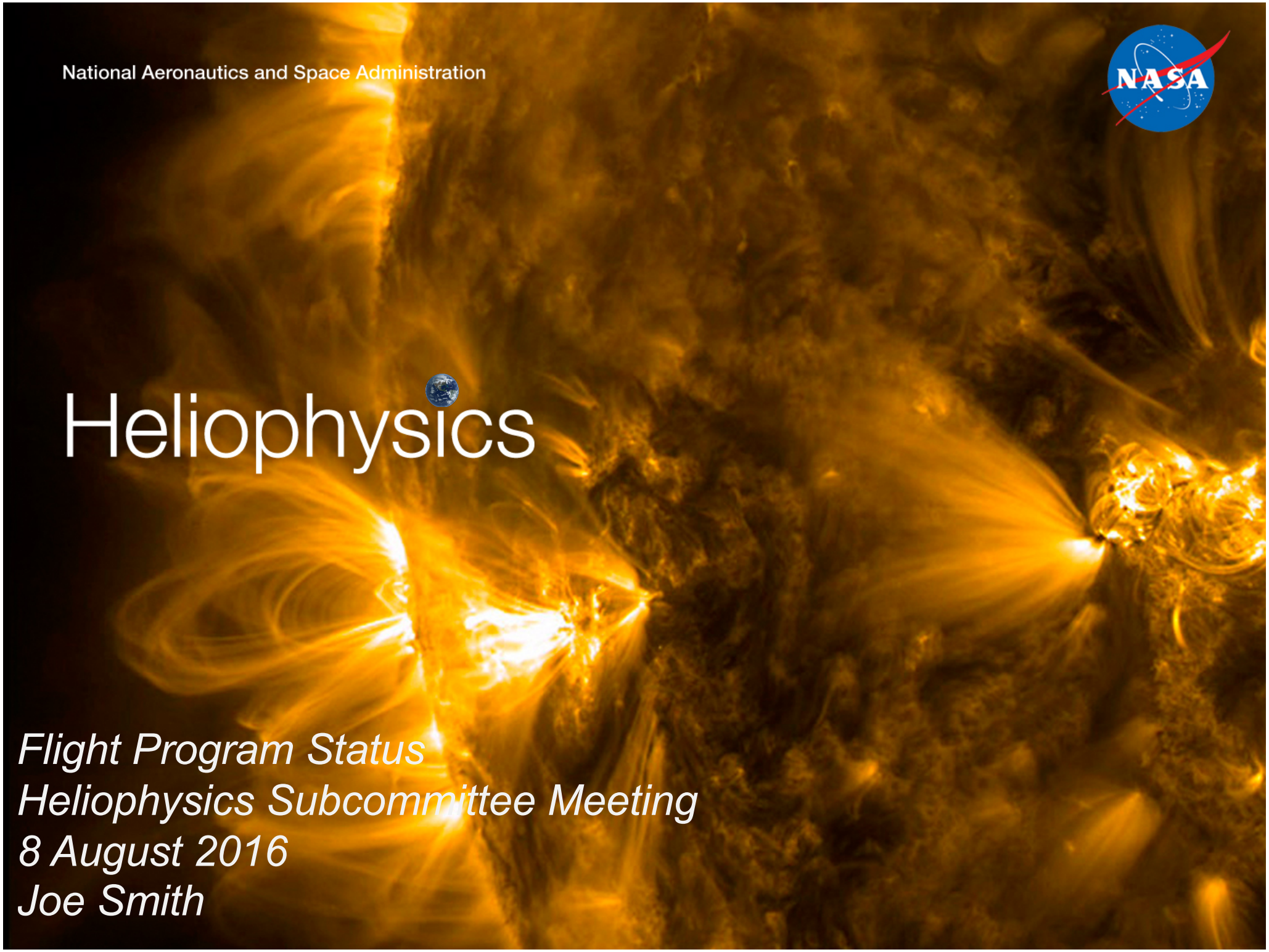
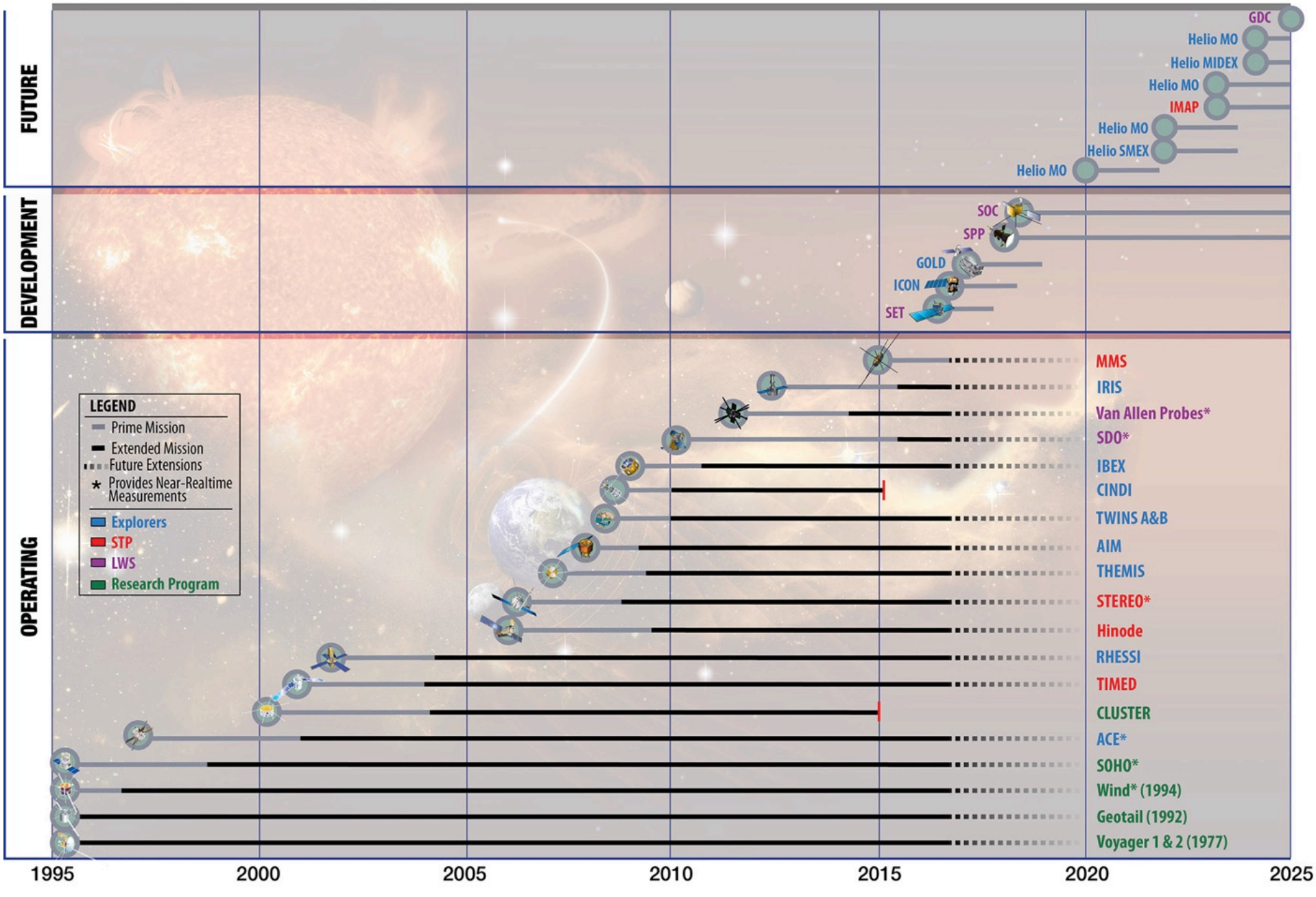
National Aeronautics and Space Administration



Heliophysics

Flight Program Status
Heliophysics Subcommittee Meeting
8 August 2016
Joe Smith

Heliophysics Mission Timeline 1995-2025



Magnetospheric Multiscale (MMS) Mission

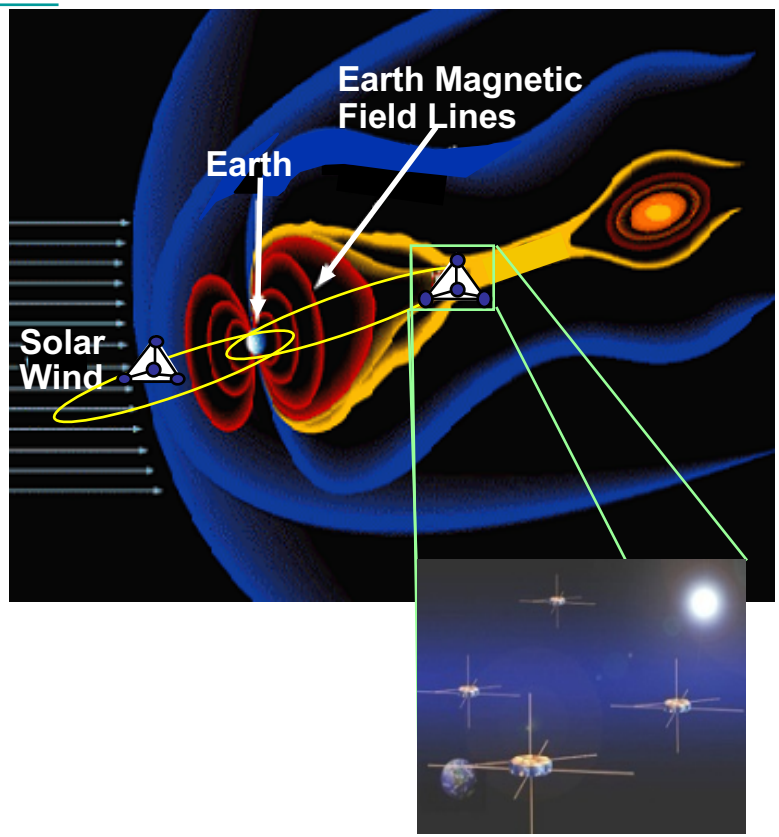
Description: MMS is a Solar Terrestrial Probes mission with four identically instrumented spacecraft that use Earth's magnetosphere as a laboratory to study the microphysics of magnetic reconnection.

Recent Accomplishments:

- Results papers online at Geophysical Research Letters:

http://onlinelibrary.wiley.com/10.1002/(ISSN)1944-8007/specialsection/NASA_MMS1

- Star Tracker issue resolved.



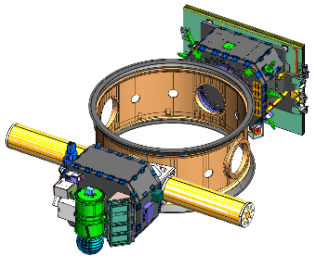
Planning Items:

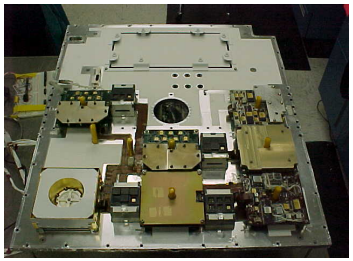
- MMS Science Workshop #1, UCLA, 7-9 September
  - Over 100 papers submitted
- Phase 1B science ops will begin 12 September
  - Tetrahedron mean spacing 7 km
- AGU 12-16 December
  - Two team-convened special sessions:
    - dayside magnetopause processes
    - inner magnetotail processes

Watch Items/Concerns:

- None.

LWS Space Environment Testbeds (SET)-1





Launch Information:

- **Spacecraft:** AFRL Deployable Structures Experiment (DSX)
- **Launch Vehicle**: SpaceX Falcon Heavy
- **Date**: March 2017
- **Site**: Cape Canaveral
- **Orbit**: 6000 x 12,000 km, 45 degree inclination MEO

Description:
Space Environment Testbeds (SET) improves the engineering approach to accommodate and/or mitigate the effects of solar variability on spacecraft design and operations by: 1) collecting data in space to develop a physics-based understanding of response of spacecraft materials, components, & sensors/detectors to space environments; 2) collecting data in space to validate new & existing ground test protocols for the effects of solar variability on emerging technologies; and 3) developing & validating engineering environment models, tools, & databases for spacecraft design & operations.

Accomplishments:

- DSX Spacecraft successfully completed Factory Compatibility Test (FTC, end-to-end test)

Upcoming Milestones:

- Solar Array Acoustic Test – September 2016
- TVAC tests planned for October-November 2016.

Watch Items/Concerns:

- None

Ionospheric Connection Explorer (ICON)

Description: ICON will explore the boundary between Earth and space to understand the physical connection between our world and our space environment. ICON will launch on a Pegasus XL launching from Kwajalein Atoll in October 2017. The spacecraft will be placed in a LEO Orbit at 575 km with a 27° inclination. The payload consists of four instruments, MIGHTI (NRL) – neutral wind measurements; IVM (UT Dallas) – in situ ion velocities; and FUV & EUV imaging UV spectrographs (UC Berkeley) – ion density.

Recent Accomplishments:

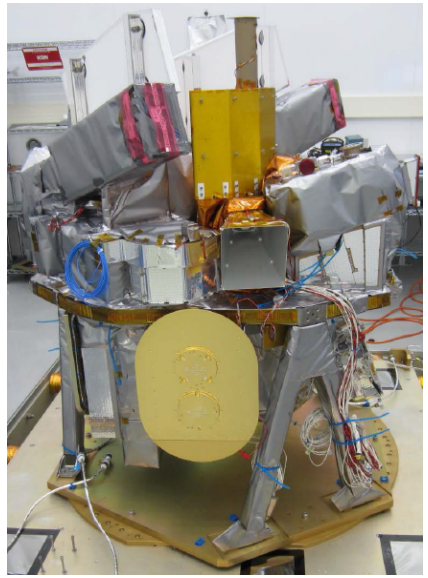
- Integrated Payload completed Environmental Test Program
- Pre-Ship Review 4 August. Successful.
- Spacecraft in bake-out prior to Observatory Integration

Upcoming Milestones/Events:

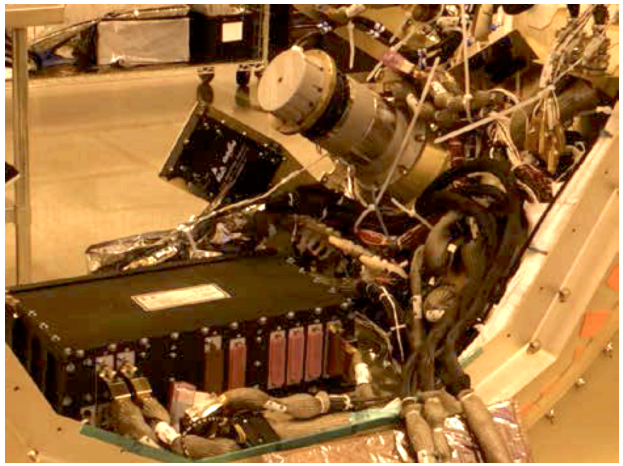
- System Integration Review – 10-11 August 2016
- Key Decision Point-D – 26 August 2016
- Pre-Environmental Review – 20-21 September 2016
- LRD – October 2017

Issues/Concerns:

- Orbital Debris waiver in signature routing at Goddard.



Integrated Payload



Integrated Bus

GOLD
- Global Observations of the Limb And Disk -

Description: GOLD is an Explorer Program Mission of Opportunity that will provide the first simultaneous measurements of temperatures and composition in Earth's thermosphere and ionosphere on a global scale. GOLD will fly a UV imaging spectrograph as a hosted payload on a commercial communications spacecraft in geostationary orbit.

Recent Accomplishments:

- Completed:
  - ✓ Instrument-level vibration test
  - ✓ Comprehensive Performance Test and alignment check.
  - ✓ Thermal Balance Test
- Currently in Thermal Vacuum Testing

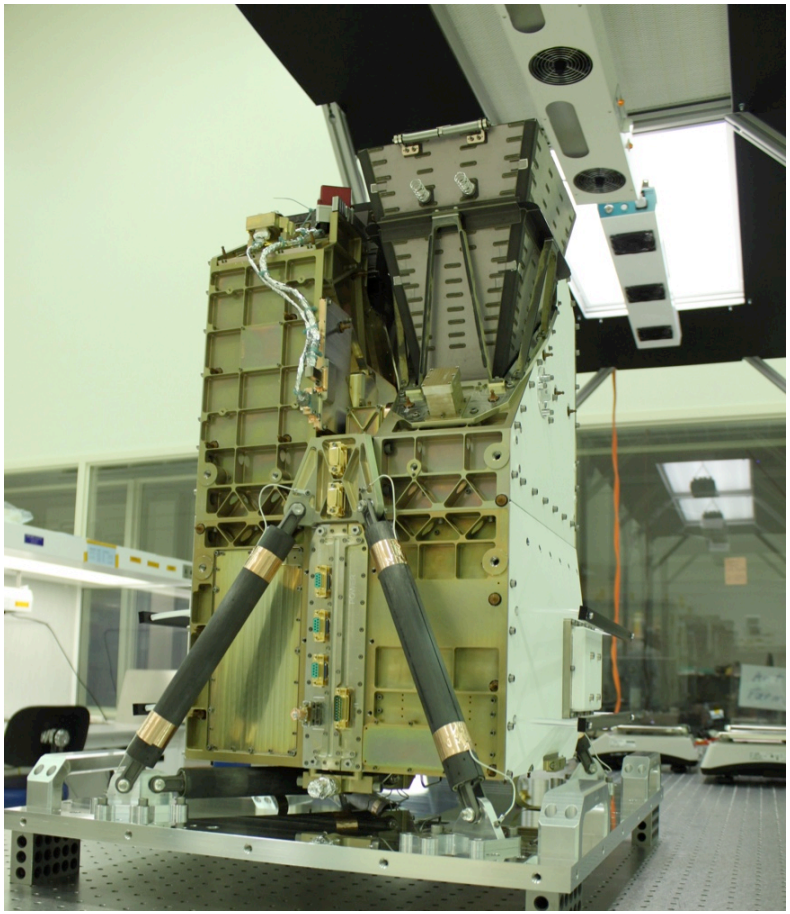
Upcoming Milestones/Events:

- Pre-Ship Review – 26 October 2016
- LRD – April 2018

Issues/Concerns:

- None

Channel 1 and 2 Pre-Test



Solar Probe Plus (SPP)

Description

Spacecraft in a highly eccentric elliptical orbit with a minimum perihelion of 9.9 Solar Radii (~4.3 million miles). Employs a combination of in-situ measurements and imaging to achieve the mission's primary scientific goal: to understand how the Sun's corona is heated and how the solar wind is accelerated.

Recent Accomplishments

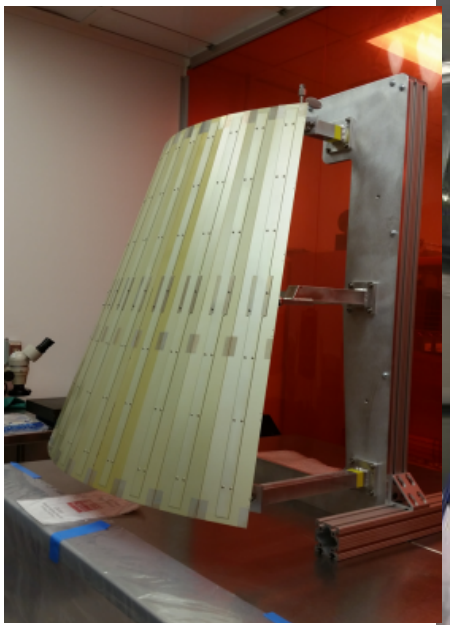
- KDP-D APMC – 7 July. Successful.
- Integration and testing initiated at APL
- Spacecraft Harness Hi-Pot Testing ongoing

Upcoming Milestones

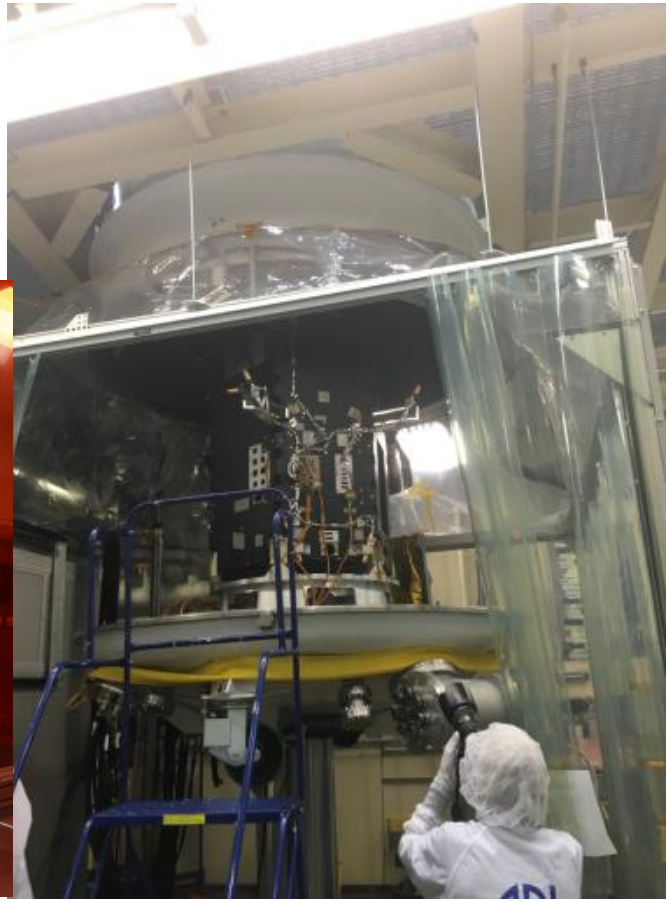
- Pre-Environmental Review – 6 October 2017
- Pre-Ship Review – 8 March 2018
- LRD – 31 July 2018

Issues/Concerns

- None



Solar Array Cooling System Radiator #1



Started Flight Propulsion Thermal Verification Testing at APL

Solar Orbiter Collaboration (SOC)

Description: Will use a unique combination of measurements: *In situ* measurements will be used alongside remote sensing, close to the sun (~.3 AU), to relate these measurements back to their source regions and structures on the sun's surface. Operates both in and out of the ecliptic plane. Measures solar wind plasma, fields, waves and energetic particles close enough to the Sun to ensure that they are still relatively pristine.

Recent Accomplishments:

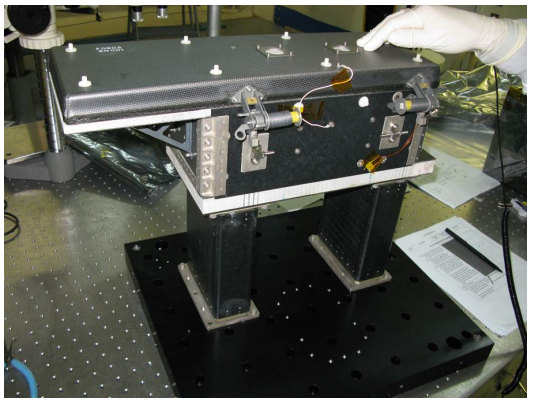
- ESA Mission CDR 9 June. Successful. Maintaining October 2018 launch
- ESA increasing NASA involvement in scheduling activities and Systems Engineering efforts
- ESA/Airbus adjusting instrument deliveries (later)
- Heavy Ion Sensor instrument High-Voltage Power Supply Testing Ongoing
- SoloHI Instrument Pre-Environmental Review 28 July

Upcoming Milestones:

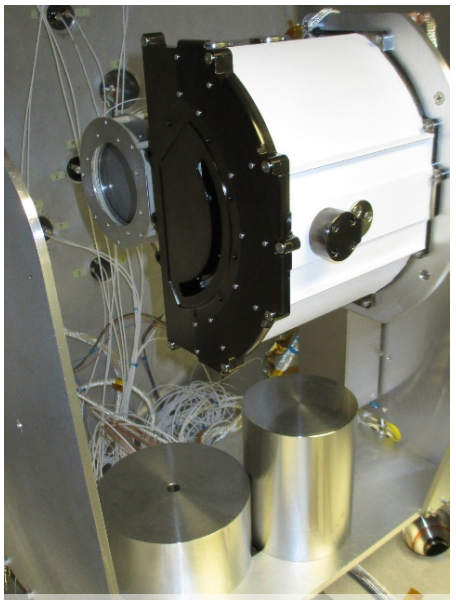
• HIS Pre-Environmental Review	Aug 2016
• SoloHI Pre-Ship Review	Oct 2016
• HIS Pre-Ship Review	Dec 2016
• LRD	Oct 2018

Watch Items/Concerns:

- Schedule risk (spacecraft) to LRD



SoloHI Instrument Module with door integrated



HIS configured for Phase 2 beam testing (with parallel beam monitor installed)

Heliophysics Missions in Formulation & Development
Director's Assessment

8/4/16

Project	Overall previous months				This Month					Comments
	-4	-3	-2	-1	O	T	C	S	P	
Development										
EX-GOLD Apr 2018	G	G	G	G	G	G	G	G	G	
EX- ICON Oct 2017	G	G	G	G	G	G	G	G	Y	ODAR in signature cycle at Goddard.
LWS-SPP Jul 2018	G	G	G	G	G	G	G	G	G	
LWS-SOC Oct 2018	G	G	Y	G/Y	G/Y	G/Y	G	G/Y	Y	HIS HVPS progressing well. Instrument schedules being negotiated with ESA. Oct 2018 LRD schedule watch.
LWS – SET Mar 2016	G	G	G	G	G	G	G	G	G	

T: Technical, S: Schedule, P: Programmatic,
C: $ resources, O: overall

On plan, adequate Margin

Problems, working to resolve within planned Margin

Problems, not enough margin to recover

Status of HPD Operating Missions

HELIOPHYSICS

7/14/16

Mission	Launch	Phase	Extension to (*)	M-3	M-2	M-1	Cur. M.	Remarks
Geotail	7/24/1992	Extended	12/31/2016					
STEREO	10/25/2006	Extended	9/30/2018					Still no response from B. Project plan forward accepted by HQ 6/13.
THEMIS+Artemis	2/17/2007	Extended	9/30/2018					on 6/15 D lost of data: 7/2 A lost 31h of data. Both antenna issues.
AIM	4/25/2007	Extended	9/30/2018					
Hinode	9/23/2006	Extended	9/30/2018					
ACE	8/27/1997	Extended	9/30/2018					
RHESSI	2/5/2002	Extended	9/30/2018					
SOHO	12/2/1995	Extended	9/30/2018					
TIMED	12/7/2001	Extended	9/30/2018					
Voyager 1 + 2	8/20/1977	Extended	9/30/2018					
TWINS A + B	6/2006 & 3/2008	Extended	9/30/2018					
IBEX	10/19/2008	Extended	9/30/2018					Star tracker issue resolved.
Wind	11/1/1994	Extended	9/30/2018					
SDO	2/11/2010	Extended	9/30/2018					
Van Allen	8/30/2012	Extended	9/30/2018					
IRIS	6/27/2013	Extended	9/30/2018					Star Tracker issues should be closed soon.
MMS	3/12/2015	Prime	9/1/2017					Star tracker issue resolved.

(*) Extended mission end dates subject to upcoming Senior Reviews. (+) Terminates at date.

Mission proceeding to meet science requirements

Area of concern - possible reduction in capability

Sounding Rocket Science Highlights
June 2016

Successful Wallops Flight Facility Launch: RockON/RockSAT-C

NASA successfully launched a Terrier-Improved Orion suborbital sounding rocket carrying student experiments with the RockOn/RockSat-C programs on June 24.

More than 200 middle school, high school, community college and university students and instructors participating in Rocket Week at Wallops were on hand to witness the launch.

Through RockOn and RockSat-C students are learning and applying skills required to develop experiments for suborbital rocket flight. In addition, high school educators through the Wallops Rocket Academy for Teachers (WRATS) are learning about applying rocketry basics in their curriculum.

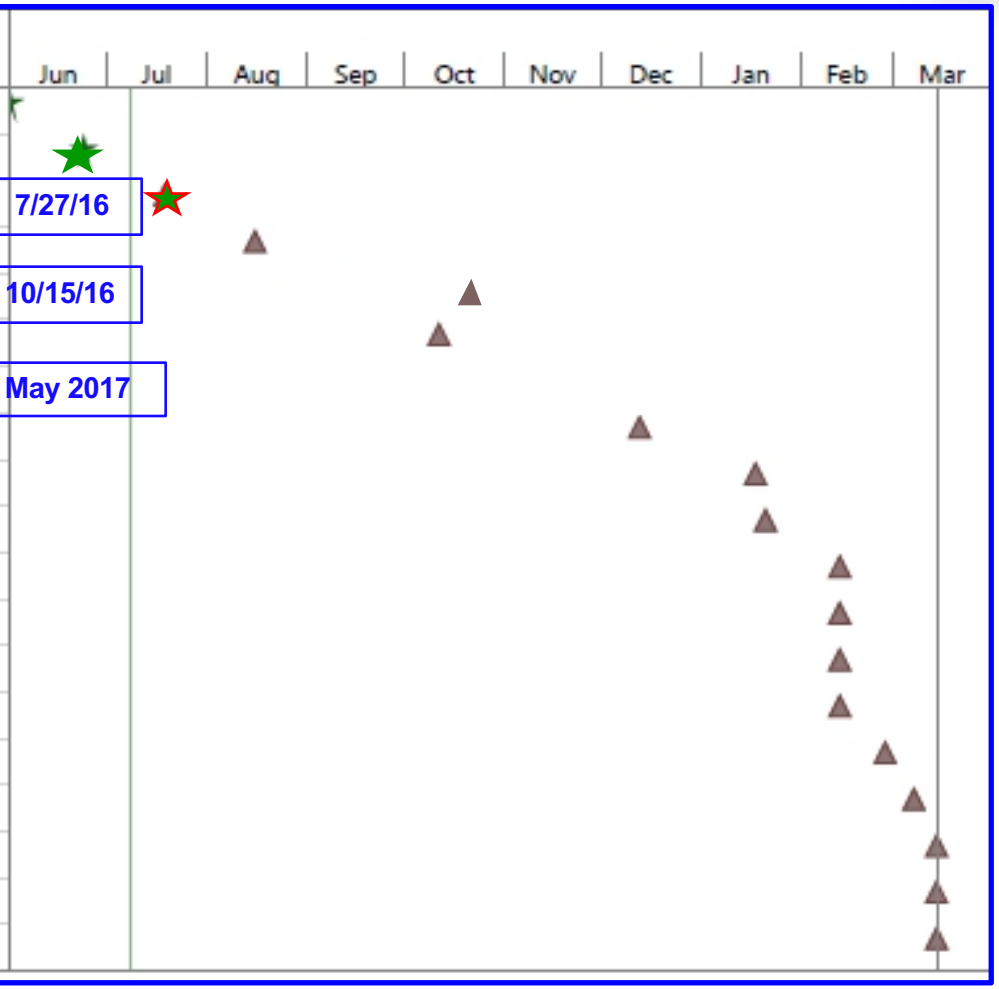
The next launch from NASA's Wallops Flight Facility is a Terrier-Improved Malemute suborbital sounding rocket currently scheduled for August 16. The rocket will be carrying the RockSat-X education payload.

For more information on NASA's Wallops Flight Facility, visit: http://www.nasa.gov/wallops

Sounding Rockets Launch Schedule
June 2016 – March 2017

Updated 8/4/16

Mission Title	Launch Date
WOODS SDO-EVE WS	Wed 6/1/16
KOEHLER ROCKON - RockSAT-C WI	Fri 6/24/16
CIRTAIN HiC WS	~~Tue 7/19/16~~ → 7/27/16
KOEHLER RockSAT-X WI	Tue 8/16/16
CHRISLEY ZOMBIE WS	~~Thu 9/15/16~~ → 10/15/16
HASSLER RAISE WS	Wed 10/12/16
BOCK CIBER-2 WS	~~Thu 12/1/16~~ → May 2017
HESH SUBTEC 7 WI	Tue 12/13/16
LARSEN AZURE FB	Wed 1/18/17
BAILEY POLARNOX FB	Sat 1/21/17
PFAFF JETS FB	Mon 2/13/17
LYNCH ISINGLASS FB	Mon 2/13/17
LYNCH ISINGLASS FB	Mon 2/13/17
PFAFF JETS FB	Mon 2/13/17
MILLINER WI	Mon 2/27/17
TUN BELTRAN HERSCHEL WS	Wed 3/8/17
DAW EUNIS WS	Wed 3/15/17
CHRISLEY ZOMBIE WS	Wed 3/15/17
CHRISLEY ZOMBIE WS	Wed 3/15/17



Backup

Acronym List

- ABC – Agency Baseline Commitment
- ACE – Advanced Composition Explorer
- AFRL – Air Force Research Laboratory
- AIM – Aeronomy of Ice in the Mesosphere
- AO – Announcement of Opportunity
- BARREL – Balloon Array for Radiation Relativistic Electron Losses
- CINDI – Coupled Ion Neutral Dynamic Investigation
- CDR – Critical Design Review
- EM – Engineering Model
- EMC – Electromagnetic Compatibility
- EMI – Electromagnetic Interference
- EUV – Extreme Ultraviolet
- FM – Flight Model
- FPGA – Field Programmable Gate Array
- FRB – Failure Review Board
- FUV – Far Ultraviolet
- GOLD – Global-scale Observations of the Limb and Disk
- GRIPS -- Gamma-Ray Imager/Polarimeter for Solar flares
- HIS – Heavy Ion Sensor
- HVPS – High Voltage Power Supply
- IBEX – Interstellar Boundary Explorer
- ICON – Ionospheric Connection Explorer
- ICP -- Instrument Control Package
- IMAU -- ICON Master Avionic Unit
- IRAP – Industrial Research Assistance Program
- IRIS – Interface Region Imaging Spectrograph
- IVM -- Ion Velocity Meter
- KDP – Key Decision Point
- LCC – Life Cycle Cost
- LRD – Launch Readiness Date
- LVPS – Low Voltage Power Supply
- LWS – Living With a Star
- MCP – Micro-Channel Plate
- MEO – Medium Earth Orbit
- MIDEX – Medium-Class Explorer
- MIGHTI -- Michelson Interferometer for Global High resolution Thermospheric Imaging
- MMS – Magnetospheric Multi-Scale
- MoO – Mission of Opportunity
- MOR – Mission Operations Review
- NRA – NASA Research Announcement
- PER – Pre-Environmental Review
- PDR – Preliminary Design Review
- PI – Principal Investigator
- PIP – Payload Interface Plate
- PSR – Pre-Ship Review
- RHESSI – Ramaty High-Energy Solar Spectroscopic Imager
- ROSES – Research Opportunities in Space and Earth Sciences
- SDL – Space Dynamics Laboratory
- SDO – Solar Dynamics Observatory
- SET – Space Environment Testbed
- SIR – System Integration Review
- SMEX – Small Explorer
- SOC – Solar Orbiter Collaboration
- SoloHI -- Solar Orbiter Heliospheric Imager
- SPP – Solar Probe Plus
- STEREO – Solar-Terrestrial Relations Observatory
- STP – Solar Terrestrial Probes
- THEMIS – Time History of Events and Macroscale Interactions during Substorms

Acronym List (Cont'd)

- TIMED – Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics
- TVAC – Thermal Vacuum
- TWINS – Two Wide-Angle Imaging Neutral-Atom Spectrometers
- UCB/SSL – UC Berkeley/Space Sciences Laboratory
- UFE – Unallocated Future Expenses